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Boosting deep renovation in the Nordic Countries

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Abstract

Buildings are a strategic sector for energy policy. The Energy Performance of Buildings Directive together with the Energy Efficiency Directive and the Renewable Energy Sources Directive, define a framework that creates the conditions for long term improvements in the energy performance of Europe's building stock. The Article 4 of EED requires Member States "to establish a long-term strategy beyond 2020 for mobilising investment in the renovation of residential and commercial buildings”. The Member States have developed their first renovation strategies in 2014 and will update them in 2017. These strategies have been assessed. Countries in the early stages of the energy efficient building construction get easily good estimates because they could present plenty of Kyoto pyramid theory style new openings. If the energy performance is poor, it is easy to get big energy savings by reducing consumption what is the foundation for energy efficient building stock according Kyoto Pyramid. In the Nordic Countries energy efficient building construction has been for decades “business as usual” so big savings are not achievable. This paper discusses whether the Kyoto pyramid of priorities could be seen as steps. The sensible energy efficiency improvement measures depend on the step where member state is. If energy performance of buildings is already good, the investments should be head to enhance energy efficiency and promotion of renewable energies.

Keywords: Building stock, deep renovation, energy, strategy, Kyoto pyramid

1. Introduction

1.1 Background

Energy efficiency has become a key priority of the Europe 2020 strategy for smart, sustainable and inclusive growth and resource efficiency (EU, 2010c). Through efficiency, security of energy supply will be improved, emissions will be reduced and energy reserves wasted due to inefficiency will be recovered.

The EU's updated strategy, which will extend up to 2030, has the aim of reducing greenhouse gases by 40 percent compared to the 1990 level. In addition, a binding target has been set for the use of renewable energy (EU, 2014). The Paris climate agreement signed in the autumn of 2015 will further tighten requirements set for the energy efficiency of buildings and the adoption of renewable energy (UN, 2015).

The first step in implementing the strategy with regard to the existing building stock was the requirement to improve energy efficiency during renovations (EU, 2010b). In addition, the public sector has been tasked with setting an example by entering into energy efficiency agreements, improving the energy efficiency of public buildings, making energy efficiency a criterion for awarding public contracts, and obliging energy companies to help consumers cut energy consumption.

The energy efficiency of buildings is regulated by a specific 'Energy Performance of Building Directive (EPBD)'. However, the generally applicable Energy Efficiency Directive (EED) requires measures that go further. It requires member States to incentivise investment in the deep renovation of buildings (EU, 2012). Construction is also subject to the Renewable Energy Directive (EU, 2009) on the use of renewable energy and the Eco Design Directive on the energy efficiency of products (EU, 2010a). Energy performance certificates (EPC) are a result of regulations such as these.

A Deep Renovation Strategy must be drawn up at three-year intervals. A 'deep renovation' in accordance with the Energy Efficiency Directive is a cost-effective renovation which leads to a refurbishment that reduces both the delivered and final energy consumption of a building by a significant percentage compared with the pre-renovation levels leading to a very high energy performance. Such deep renovations could also be carried out in stages. EU (2013) indicates that the significant efficiency improvements resulting from deep renovation are typically of more than 60 percent energy. The requirement for high savings per cent follows the priority presented in the Kyoto pyramid (Figure 1) The private sector is even more ambitious having at least 75 percent energy saving target within deep renovation (GBPN, 2013).

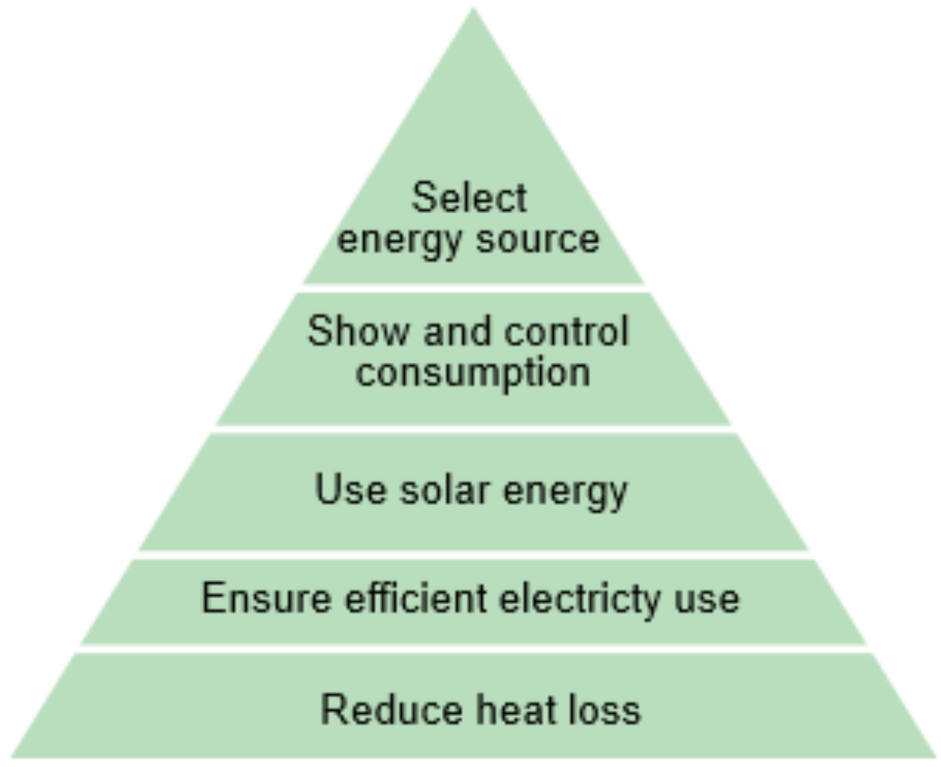

Figure 1. Kyoto pyramid principles in energy efficiency improvements.

The first Deep Renovation strategies were submitted for evaluation in the spring of 2014. It was assumed that the strategy would be a 'piece of cake' for the Nordic countries, where the energy efficiency of buildings is already high due to the cold climate and the energy crises of the 1970s. However, the evaluation of the Member States' strategies produced a surprise: the Nordic countries' strategies were rated below the average for the 27 countries assessed (JRC, 2016).

Estimated energy savings of the existing building stock are in the Nordic countries between 12..-35 percent to the year 2050 (Table 1). These figures are far from presented Deep Renovation target at least 60 percent.

	Denmark	*Finland*	*Sweden*
% change of total GWh	*-35 %*	*-20 %*	*-12 %..-25 %*

Table 1. Expected energy saving 2014-2050 in percent (heating energy and hot water)

1.2 Research question, method and material

The objective was to acquire understanding why top professionals of energy-efficient construction did not meet the criteria of Deep Renovation Strategy. The Kyoto Pyramid was used as framework for this case study.

A literature review forms the basis of the research method. The research material from Sweden, Denmark and Finland comprised material – produced by Nordic public authorities and research institutes – on the renovation of the building stock. It includes statistics of the building stock, legislation, regulations, and reports drawn up for the EU, on the implementation of the Energy Efficiency Directive (EED) and Energy Performance of Buildings Directive (EPBD).

2. Renovation strategies in Nordic Countries

2.1 Denmark

In Denmark, construction is regulated by the Building Act and building regulations (BR, 2015), the Act on Listed Buildings and Preservation of Buildings and Urban Environments (LBK, 2014), energy-

labelling legislation and regulations (LBK, 2016). When the Building Act was amended in 2010, the requirements set by building regulations were adjusted to apply to all renovation projects. Financing for improving the energy efficiency of old buildings must be sourced from the market. However, such improvements are also promoted via publicly funded advice, for example through information and education targeted at households. Also tool has been developed for construction sector projects. Financial support is provided in the form of tax deductions.

The energy requirements for new buildings have been steadily tightened since the 1970s energy crisis. Denmark sees that they have built up considerable expertise and, compared to other countries. Key components of Danish deep renovation strategy (Denmark, 2014) are 1) transparent market for renovations, 2) besides reduction of energy consumption also broader aspect of sustainability are taken account and 3) heating systems are converted to use renewable energy. The Danish strategy also includes cross-cutting initiatives relating to skills and innovation. These initiatives are intended to overcome barriers in promoting energy renovation by increased investment in training and skills development within energy renovation and a greater emphasis on research, innovation and demonstration.

2.2 Finland

In Finland, construction is guided by the Land Use and Building Act (YM, 1999) and the means of combating climate change set forth in the Climate Change Act (YM, 2014). More detailed regulations on the energy efficiency of buildings are issued separately for new construction (YM, 2012) and renovation (YM, 2013).

Finland's national strategy (Finland, 2014) emphasises innovation and technology dissemination, communications, skilled labour and education. Lessons learnt about the best ways to improve energy efficiency as well as successful projects need to be shared. Property owners are encouraged to introduce improvements in connection with normal structural repairs and system upgrades. The concept of energy efficiency as an integral part of all renovations should be emphasised by incorporating it into the curriculum at all levels of construction education. Courses have to be targeted for both young people and mature students and for both new recruits and professionals who have already established themselves in the industry.

2.3 Sweden

In Sweden, the Energy Efficiency Directive has been enacted via the Planning and Building Act (SFS, 2010), the Act on Energy Metering in Buildings (SFS, 2011) and supplementary decrees and building regulations, as well as general guidelines (BFS, 2016). The energy economy is evaluated on a holistic basis. Despite the fact that requirements have been set for energy consumption, the minimum level of building insulation, and electricity consumption and energy consumption metering, there is almost unlimited choice with respect to implementation methods. The energy efficiency of the old building stock is also promoted through other measures. The authorities maintain a range of guidelines, such as general guidelines on the alteration of buildings (BÄR, 2006). Briefing sessions have been organised by the Swedish Energy Agency, which has also drawn up recommendations for large-scale, nearly zero energy renovations. In addition, a range of provincial and municipal-level advice and technical assistance is available. Financial incentives include tax reductions and support for solar heating.

Previously Sweden had a target for improving the energy efficiency of the building stock. In 2010, a new structure of targets for the environmental target system was formulated. New target of a Well-Built Environment stresses a good, healthy living environment and contributes to a good regional and global environment. Sweden sees that they have an energy-efficient building stock compared with many other European countries. Deep renovation strategy (Sweden, 2014) bases on the assumption that there is an obvious opportunity to increase the energy efficiency of existing buildings in future 1) by well-working market, 2) by existing instruments (technology procurement and networks, subsidies to beyond the state of art projects, research, advice bodies, etc.) and 3) natural regeneration (renovation automatically improves energy efficiency, since components are replaced with more energy efficient ones).

2.4 Requirements from Nordic point of view

High scores tend to be given to countries which have reported their findings in minute detail (JRC, 2016). The Nordic countries would probably have produced similar reports in the 1970s, when renovation became a research topic in those countries. In the wake of the 1970s energy crises, a great deal of research was done on issues such as additional insulation, 3-glass windows and what to do about oil-based heating.

In its assessment, the EU placed an emphasis on changes in the number of renovated buildings (JRC, 2016). Raising the number of renovated buildings from zero to a thousand in just a few years would constitute a major change of this kind. A large decrease in consumption also earned a high score. If the performance of a building is poor, thermal insulation, better windows and central heating can easily reduce energy consumption by 60-80 percent. The situation is entirely different in the Nordic countries, where buildings that were insulated and connected to district heating networks during the building stage, are now starting to be renovated. Such buildings have less energy-saving potential than those with less insulation.

New financial instruments were another highly valued factor in the EU’s strategy assessment report (JRC, 2016). In some European countries, it is possible to bring the instruments of international financial institutions onto the markets. This is not an option for rich countries. An unspoken rule of the market economy is raising prices by public support. R&D should be the means of ensuring that product prices and features are attractive to customers and products are affordable without public subsidies.

2.5 Key indicators of building energy performance against Kyoto pyramid

The Kyoto pyramid principles are reduction of heat losses, reduction of energy usage, utilization of solar energy, showing and regulating the energy use and choosing local energy source. Emphasis on structural renovations (level 1 in pyramid) is due the fact that two third of the EU's buildings were built when energy efficiency requirements were limited or non – existent. Most of these buildings will still be standing in 2050. It is estimated that huge savings can be achieved through simple renovations such as insulating the attic, walls and foundations, and installing double or triple glazing. The most cost efficient way is carrying out those measures within ordinary renovations (EU, 2016). Table 2 presents key indicators of building’s energy performance in Nordic Countries.

Table 2. Kyoto Pyramid objectives / Key indicators of building energy performances in Nordic countries.

	Finland	*Sweden*	*Denmark*
Select energy source renewable energy (RES) *Heating*	*Converting to renewable energy ~ 48%*	*Strong use of heat pumps ~ 58%*	*Converting to renewable energy* *~ 29%*
Electricity	*~ 65 %*	*~50 %*	*~ 55 %*
Show and control consumption *(DH=district heating)*	*Electricity: 100 % smart metering* *DH: building level smart metering*	*Electricity: 100 % smart metering* *DH: building level smart metering*	*Electricity: 100 % smart metering* *DH: individual smart metering*
Solar electricity & heat	*< 1%*	*< 1%*	*~ 3%*
Efficient electricity use	*3,9 MWH/capita/a*	*3,8 MWh/capita/a*	*1,8 MWh/capita/a*
Reduce heat loss, facade, roof, windows	*Energy requirements have tightened continuously after 1970s*	*Energy requirements have tightened continuously after 1970s*	*Energy requirements have tightened continuously after 1970s*

Reduction of heat losses: All Nordic countries have established regulation to decrease structural energy use (windows, facades, roofs) already since 1970´s. The starting point was energy crisis during 1970´s. After that has regulation become more and more tight and in the future there will be nearly zero energy buildings. Comparing Nordic countries to other European countries there is not much possibility to save energy in reasonable prices.

Efficient electricity use: The specific domestic electricity consumption is high in all Nordic countries. Reasons for this are electric space heating, saunas in Finland, lighting during the dark wintertime, etc. There is big potential to use energy more efficient.

Solar energy: Solar energy is not common in Nordic countries. The share of solar energy is in Denmark about 3 % and in Sweden and Finland below 1 %. Sunny countries like Malta, Cyprus, Portugal and Greece are using 2-15 % solar power in heating.

RES in heating: In Finland RES heating is produced by 2/3 wood and biomass and 1/3 waste RES and geothermal heat. IN Sweden RES heating power is produced by nearly all biomass and Denmark about half of biomass and half of waste RES. All countries are increasing RES in heating. Nordic countries has already quite good situation with use of RES compared to other European countries.

In Kyoto pyramid principles in the Nordic countries there are minor possibilities in level 1 reduce heat loss. There are some possibilities to reduce household electricity use. The biggest reduction possibilities are at levels 3.4 and 5. Instead Kyoto pyramid, Kyoto Cube describes what better the most feasible ways to cut energy use of old buildings. This also explains poor scores what Nordic countries got from assessment of Deep renovation strategies.

3. Conclusion

This paper has discussed the Nordic countries' strategies for the energy-efficient improvement of their old building stock. The Nordic countries have long traditions in improving energy efficiency, which stretch back to the energy crises of the 1970s. They also have a great deal of experience and expertise in the energy efficiency of buildings. Over the decades, this has become integral to construction in such countries. Instead, the foundations of Kyoto Pyramid (reduction of heat loss) the most cost effective investment target can be found in the Nordic countries from Kyoto pyramid levels 3) use of solar energy, 4) show and control consumption and 5) select of energy source. Not anymore in reasonable price from Kyoto pyramid level 1) to reduce of the heat loss.

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